

SPAR Model Use in Risk-Informed Applications

NRC's SPAR models provide consistent and up-to-date risk models for use in regulatory decision-making, evaluation of inspection findings, and precursor studies.



U.S. Nuclear Regulatory Commission

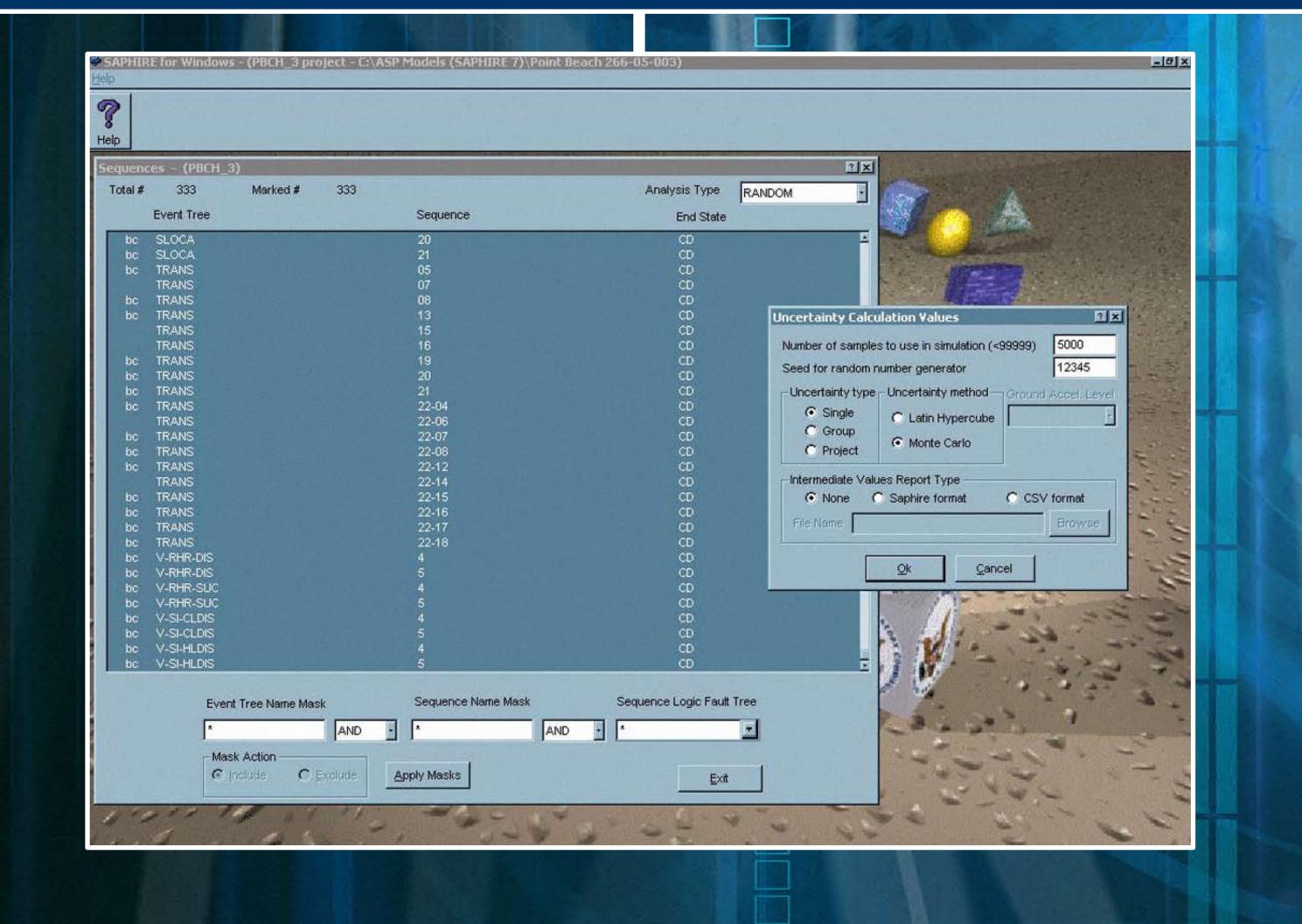
NRC's SAPHIRE computer code provides state-of-the-art PRA calculation capability.

SAPHIRE Features:

- Sequence and cutset quantification
- Event analysis tool (Graphical Evaluation Module)
- Uncertainty analysis
- Importance measures

- Nuclear Regulatory Commission (NRC)
- Licensees
- National Aeronautics and Space Administration (NASA)
- Co-operative foreign program countries
- SAPHIRE Users Group

For more information go to www.saphire.inel.gov



Operating Event Data

- Licensee event reports
- Equipment Performance Information and Exchange (EPIX) Database
- Reactor Oversight Process (ROP) Safety System Unavailability (SSU) **Performance Indicators**
- Common-cause Failure Database

For more information go to the NRC public webpage, Reactor Operational Experience Results and Databases http://nrcoe.inel.gov/results

Licensee PRAs

Licensee probabilistic risk assessments (PRAs) are used to verify SPAR models via the following:

- Onsite quality assurance reviews
- Benchmarked against licensee PRAs
- Mitigating Systems Performance Index (MSPI) - Importance measure comparison
- System scoping Outlier comparison
- Cutset reviews

SPAR Models

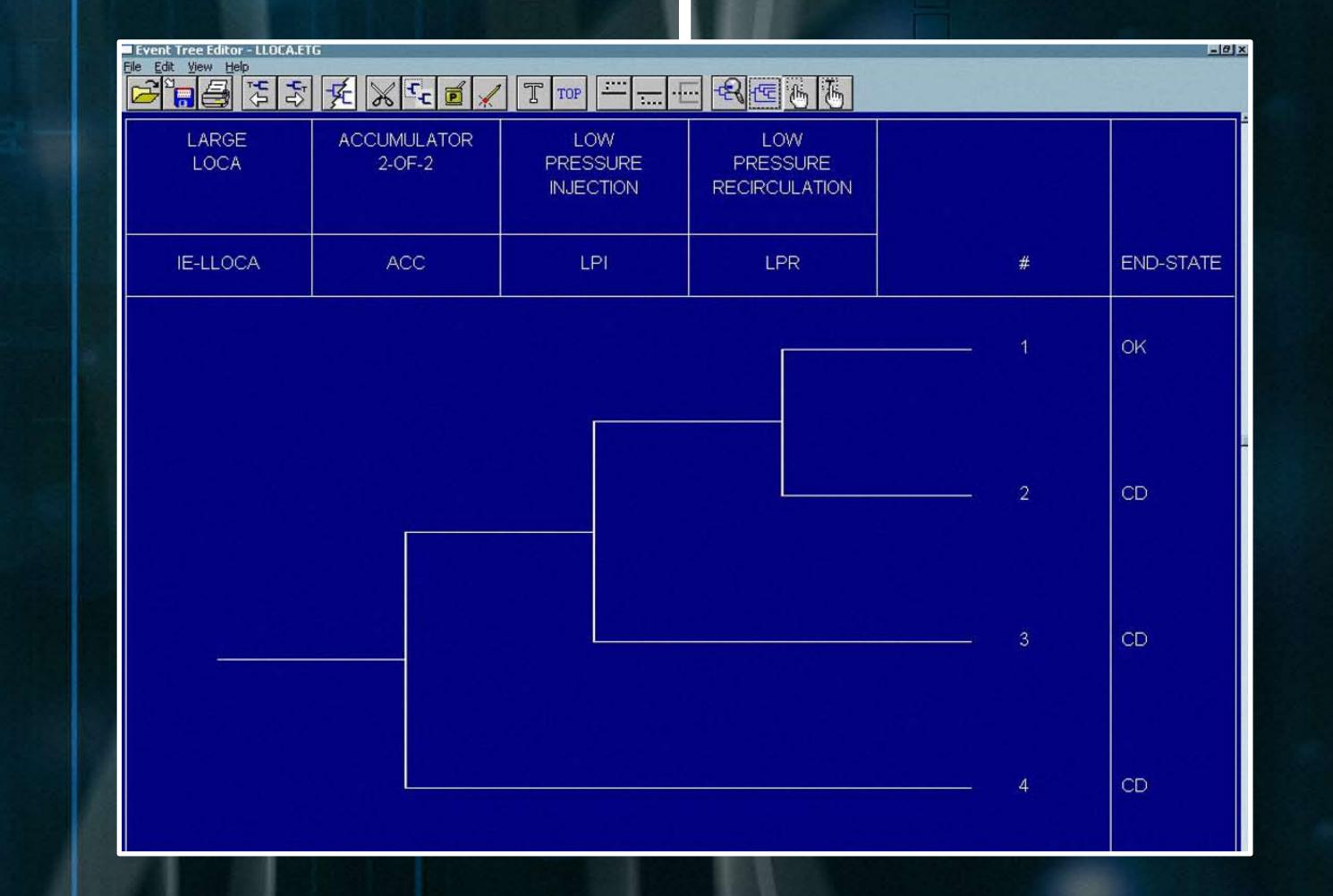
Standardized Plant Analysis Risk (SPAR) models are Level 1 PRAs, developed using consistent assumptions, nomenclature, and industry data for initiating event frequencies and component failure rates.

SPAR Model Features:

- 72 plant-specific models
- Small event tree/Large fault tree linked models
- Global updates of industry data possible
- Human reliability event estimation module (SPAR-H)

Recent SPAR Model Developments and Changes:

- Internal event models
- Added initiators (e.g., loss of service water, loss of component cooling water) - Updated basic event failure data
- Incorporated new reactor coolant pump seal loss-of-coolant accident (LOCA) model
- Loss of offsite power (LOOP) recovery curves were updated from the station blackout (SBO)/LOOP studies
- Expanding the SPAR models to allow analysis of additional initiators and plant operating states, including: - External events (e.g., fire, seismic, flooding, etc.)
- Low power/shutdown
- Large early release frequency



SDP Phase III Analyses

SPAR models are used to evaluate the risk significance of inspection findings (e.g., Significance Determination Process (SDP) Phase III analyses).

Generic Safety Issues

SPAR models are used in support of Generic Safety Issue (GSI) resolution (e.g., GSI-189 and GSI-191).

- Screening (or prioritization) analysis
- Detailed analysis to:
- Support decision-making to determine if plant modifications are required
- Assess whether the NRC should modify or eliminate an existing regulatory requirement
- Flexible and quick analyses result in minimum resources required to perform generic studies

ASP Program

SPAR models are used to evaluate risk associated with operational events and/ or degraded conditions in Accident Sequence Precursor (ASP) Program.

SBO/LOOP Studies

SPAR models are used to evaluate plant-specific and industry-wide risk from LOOP and SBO events.

- Sensitivity analyses were performed:
- Parameter substitution from NUREG-1032 and NUREG/CR-5496
- Risk difference due to seasonal changes
- Measured uncertainties for plant and industry-wide variability

License Amendment Reviews

SPAR models are used in support of risk-informed reviews of license amendments.

Performance Indicators

SPAR models are used to independently verify the MSPI.

- Verified the results from 11 plants (20 units) in the MSPI Pilot Program
- Completed importance measure comparison with licensee PRAs for all 103 plants

SPAR models are also used to provide inputs to developmental performance indicators (PIs).

- Baseline Risk Indicator for Initiating Events (BRIIE)

 currently under development
- SPAR-calculated Birnbaum values are used in indicator calculation

- Determine the required enforcement action (i.e., severity level)
- Prioritize inspection resources
- Informing stakeholders of risk increase caused by performance deficiencies
- Determine the sufficiency of proposed plant modifications
- Prevent unnecessary regulatory burden
- Provide a risk-informed input on proposed regulatory changes
- Inform all stakeholders of the risk significance of initiating events and/or degraded plant conditions
- Identify significant precursors (i.e., precursors with a conditional core damage probability or increase in core damage probability ≥ 10⁻³)
- Trend the occurrence rate of precursors
- Annual report to Congress on the number and significance of precursor events
- Provide stakeholders of up-to-date assessment of risk due to LOOP and SBO events (NUREG/CR-INL/EXT-05-00501)
- Provide SPAR input values for LOOP initiating event frequencies and recovery curves
- Reduce unnecessary regulatory burden
- Risk-inform the decision process

- Risk-informed performance indicators to replace ROP SSU Pls
- Quality improvement of SPAR and licensee PRAs

Inform Congress to changes in initiating event frequencies



RESEARCH AND DEVELOPMENT

REGULATORY ASSESSMENT

PRODUCTS AND RESULTS